REMARKS/ARGUMENTS

This case has been carefully reviewed and analyzed in view of the Official Action dated 18 November 2003. Responsive to the rejections made in the Official Action, Claims 1--10 have been amended to clarify the combination of elements that define the invention of the subject Patent Application and new Claims 11-20 have been added to more clearly define the metes and bounds of the methods disclosed in the Specification.

In the Official Action of 18 November 2003, Claim 4 is rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. In particular, the Examiner noted that the term "molecular weight" is insufficiently clear to identify exactly the type of molecular weight to which the Applicant refers. To overcome this rejection, an Affidavit signed by all of the inventors is attached stating that "the molecular weight" refers to -- and in all cases is used synonymously with -- "the weight average molecular weight," and furthermore, that this weight average molecular weight is determined by use of sedimentation velocity methods well-known to those skilled in the art of polymer chemistry. It is believed that by filing the attached Affidavit the Applicant overcomes this § 112 rejection.

The Examiner rejects Claims 1, and 7-9 under 35 U.S.C. § 102(a) as being anticipated by Pantoustier in a disclosure within an article on-line at http://www.e-polymers.com that was published on 7 August 2001. The present subject application claims a priority date of 6 September 2000, based on the PCT filing # PCT/KR 00/01205,

which is acknowledged in paragraph 12 of the Office Action Summary. Insofar as the present subject application pre-dates the Pantoustier publication it is believed that this Pantoustier article cannot be considered prior art and that the Examiner's rejection is overcome on this basis alone.

Even if, *arguendo,* the Pantoustier reference were to still be considered prior art we are also of the belief that there are patentable differences that overcome the Examiner's § 102(a) rejection. According to the methodology disclosed in the Pantoustier article that was submitted on 11 July 2001 for on-line publication, commercial grade poly(ε-caprolactone) was obtained through Solvay Chemicals, which is a combination of ε-caprolactone polyester with 1, 4-butanediol according to Solvay Company disclosures at http://www.solvaychemicals.us/pdf/CAPA6500-1003.pdf (as accessed 13 February 2004). PCL-layered silicate composites were prepared by mechanical kneading at 130°C for ten minutes, then compression molded by hot pressing at 100°C for ten minutes under atmospheric pressure, followed by compression under 150 bar for 10 seconds, then under 30 bar for 10 seconds, followed by cold pressing at 15°C under 30 bar for 5 minutes. The organophilic clays were prepared by reaction of the clay with selected alkyl ammonium cations. The entire thrust of this scientific report is that the successful synthesis of a clay-dispersed polymer nanocomposite depends significantly on whether the ammonium cations contain non-functional alkyl chains versus chains terminated by carboxylic acid or hydroxyl functions, that is, on the very particular nature

of the specific ammonium cation and its functionality. The article further documents the fact that the successful formation of PCL-based nanocomposites shows a very sensitive dependence on the selected synthetic route, either melt intercalation, solvent evaporation or *in situ* intercalative polymerization of monomers and/or oligomers. Of particular relevance for this as well as the other references cited by the Examiner in the Official Action of 18 November 2003, is Pantoustier's conclusion that "the formation of polymer layered silicate nanocomposites is not straightforward and cannot be predicted since it strongly depends on parameters such as ammonium cation type and functionality together with the production procedure, that is melt intercalation, solvent evaporation, or in situ polymerization" (Abstract, last sentence; also see the first full sentence at the top of page 3). The methodology employed by Pantoustier is the preparation of silicate PCL nanocomposites by melt intercalation, in which the layered silicate is mixed with the polymer matrix in a molten state.

The experimental work reported by Pantoustier demonstrates that "although PCL nanocomposites cannot be prepared by melt intercalation of preformed PCL chains within montmorillonite modified by the protonated form of 12-dodecanoic acid (C_2:MONT-COOH), the in situ intercalative polymerization of ε -caprolactone in the same organophilic clay (C_2:MONT-COOH) was successful as already reported..."(page 4 at bottom). "In other words, even if a given organo-modified layered silicate can intercalate a monomer with the formation of an intercalated and/or exfoliated

nanocomposite material upon consecutive polymerization, it does not mean that nanocomposites can be generated by directly blending the corresponding polymer and the same organophilic clay." (page 5 at top)

Thus, it seems that Pantoustier actually teaches away from the present subject Application methodology wherein the clay-dispersed polymer nanocomposites are shown with particularity that they can be generated by directly dry blending the polymer and the organophilic clay. Furthermore, the melt blending methodology disclosed in this on-line article involves mechanical kneading with an Aguila two-roll mill at 130° followed by a number of compression steps at various temperatures and duration. Clearly, this multi-step blending technique is different than the more simple methodology disclosed in the present subject Application in which the steps of mixing and extrusion do not require the step-wise application of different pressures. Furthermore, it seems that the methodology of Pantoustier in no place encompasses or seems to suggest the necessary step included in the currently amended Claim 1 of the present subject Application, namely, "extruding said clay-dispersed polymer nanocomposite at a predetermined temperature." Insofar as the Pantoustier reference lacks an essential element of currently amended independent claim 1, it seems to be an inadequate basis for a §102(a) rejection. It is thus believed that the currently amended Claims of the present Application overcome the §102(a) rejection based on the Pantoustier disclosure.

The Examiner further rejected Claims 1 and 6-10 under 35 U.S.C. §102(e) as being anticipated by Barbee, Patent #6,384,121. In Section 5 of the Official Action, the Examiner states that this Barbee reference "discloses use of oligomeric polycaprolactone having number average molecular weight of 2000 as intercalating agent." Perhaps the Examiner may have misinterpreted the complex methodology as disclosed in this reference. While Example 1, which the Examiner cites, does start with polycaprolactone, the initial synthetic step in this example involves the creation of a functionalized intercalating agent. As described in Column 11, Lines 18-49, the organic cations used to modify the clay starting material are shown with the chemical structure having onium-linked R groups, R1-4, which are described as independently organic and oligomeric ligands. In other words, the polycaprolactone must first be covalently joined to the ammonium species: the first synthetic step in Example 1 involves the preparation of a covalently linked polycaprolactone-ammonium. The remarks on Column 16, Line 64-Column 17, Line 6 indicate that the actual starting material is an "ammonium functionalized polycaprolactone" species to be mixed with the clay "in 150mls of water." In other words, the methodology disclosed here uses a different intercalating agent, namely an ammonium functionalized polycaprolactone, not the PCL polymer alone, as called for in currently amended Claim 1 of the present subject Application. It is furthermore prepared in an aqueous solution in contradistinction to the dry mixing called for in the currently amended Claims of the present subject Application. The

Specification of this '121 reference of Barbee does state, at Column 5, Lines 66-67, that "any melt-processible polymer or oligomer may be used in this invention." (Emphasis added.) In other words, the claim that the disclosed methods may apply to any melt-processible polymer or oligomer is qualified to the particular methodology of "this" invention, namely, the use of a PCL-ammonium molecule; not using PCL by itself and not using the dry mixing method disclosed in the present subject Application system. Because there is apparently a significant divergence in terms of starting materials and methods between this referenced Patent of Barbee and the currently amended Claims of the present Application, the Barbee '121 reference does not seem to be an adequate basis for a §102(e) rejection. Furthermore, although this referenced Patent does describe other clay treatments toward the end of Column 12, encompassing the use of "...useful organic reagents and monomers for intercalating the swellable layered clay..." which includes caprolactone, close reading of the text clearly indicates the use of the monomeric caprolactone as opposed to the polymeric caprolactone used in the present subject Application method. The Examiner further makes reference to Example 20 in Column 18 of the Barbee '121 reference; the example 20 is a follow-up synthetic step that depends on the preparation of example 1 which, as discussed above, is formed from different starting materials in an aqueous solution and therefore seems *a* fortiori not to be a properly comparable methodology.

The Examiner goes on to reject Claims 1 and 7-9 under 35 U.S.C. §102(e) as being anticipated by Barbee Patent #6,034,163. This reference, directed at polyester nanocomposites, discloses a process for manufacturing the composite material of this invention in Column 4, Lines 31-35. Barbee describes the process as comprising first the preparation of organoclay, secondly pre-swelling the organoclay material with an expanding agent, and then incorporating the expanded organoclay into a polyester.

Following the preparation of the organoclay material, Barbee discloses the second step of his invention, that is, the pre-swelling of the organoclay with an expanding agent. While Barbee does give cursory acknowledgement that there exist several methods to incorporate an expanding agent into an organoclay, including melt mixing, spray drying, and preparing the organoclay in the presence of an expanding agent, the actual methodology disclosed consistently throughout the referenced Patent of Barbee is "...to dissolve or suspend both the expanding agent and organoclay in a solvent, such as methylene chloride, then evaporate off the solvent to provide the expanded organoclay" (Column 4, Lines 48-58). Further review of the Barbee '163 reference shows that in all of his examples the methodology of his invention involves steps employing solvents. In example 1, there is an aqueous solution used; in example 2, "...the method used for preparing the expanded organoclay materials used in this invention from an organic solvent". Examples 3-16 incorporate the method and product of example 2 and therefore, also involve a non-dry mixing preparation step within the methodology. This is in

contradistinction to the essential dry mixing element of the present subject Application methodology. Although Barbee does suggest that several methods are available, in Column 4, Lines 49-58, the Pantoustier reference reinforces the well-known problem of chemical compositions, that the end products of different synthetic methods are neither predictable nor obvious. Polymer compositions are known to be extremely sensitive not only to the particular materials used, such as the particular ammonium cation, but also to the synthetic route and the conditions employed for the synthetic methodology. "Such an observation is not trivial and requires much attention when designing conditions for synthesizing polymer-layered silicate nanocomposites." (Pantoustier, last paragraph of introductory section, where he further concludes at the very last sentence of that on-line article that "clearly, it comes out that the formation of a polymer layered silicate nanocomposite, as typically shown for PCL in the present study, is not straightforward and cannot readily predict it per se" [sic].)

The fact is that while the Barbee '163 reference does refer broadly to "other methods," the particular methodology and conditions pose an experimental challenge and require the meticulous sort of experimentation that was done by the inventors of the present subject Application system to discover the effective and detailed synthetic methodology disclosed in the present subject Application. Therefore, given the fact that the methodologies actually disclosed in the '163 reference all rely on the use of solvents to prepare clay-dispersed polymer nanocomposites, there is such a significant divergence

of methodologies as to disqualify this Barbee '163 reference as a basis for the Examiner's §102(e) rejection. In other words, the Barbee '163 reference simply does not disclose the methodology of the present Application, wherein the dry blending and extrusion steps are used to efficiently and innovatively lead to the clay-dispersed polymer nanocomposite end products.

The Examiner further rejects Claims 2-5 under 35 U.S.C. 103(a) as being unpatentable over the two Barbee references, either one in view of Bragodia, U.S. Patent #6,395,386. The Examiner states in Section 10 of the Official Action, "the difference between the present invention and the disclosure of the prior art over Barbee '121 or Barbe '386 is used of different matrix polymers in addition to those already disclosed." [sic] The Examiner cites this reference of Bragodia to include polyvinyl chloride as one of the matrix polymers that "would have been obvious to one having ordinary skill in the art at the time of the instant invention." As discussed above, it is believed that the difference between the present invention and the prior art of Barbee goes significantly beyond just the use of different matrix polymers and goes to the heart of the distinctions between the specific and innovative methodology disclosed in the Specification and Claims of the present Application and the compositions of the Barbee Patents and their divergent methodologies. In Bragodia, we see again a divergence in methodologies, with the preparation steps involving the formation of a dispersion in aqueous solution, as seen in Example 2 found in Column 11 of the '386 reference. Curiously, the Bragodia seems,

at least in part, to teach away from the present subject Application methodology wherein the inventors of that reference complain in Example 3, Column 12, that "this example illustrates the poor dispersion and permeability results obtained when sodium montmorillonite without additional treatment is melt compounded with PET". The '386 reference uses a percent haze level to assess the successfulness of their synthetic process and note that haze levels greater than 2% are acceptable that reflect the lack of sufficient delamination of the clay silicate layers. The present Application methodology discloses an innovative approach to overcome the limitations disclosed inadvertently by Bragodia in Example 3 as well as subsequent Examples 4 and 5 found in Columns 13 and 14 of that '386 reference. In effect, the Bragodia reference fails to accomplish a dry mixing methodology and further largely fails to produce an end product with substantial delamination as called for in the present subject Application's newly amended Claims. The only ways that Bragodia, as well as Barbee, discloses for synthesizing the desired end product was to use a solvent based process, which stands in stark contrast to the dry mixing and extrusion methodology of the present Application as currently amended. For these reasons, the present subject Application process with its currently amended Claims seems to overcome the Examiner's § 103(a) rejection based on a combination of these references.

In Section 11, the Examiner rejects Claims 2-5 under 35 U.S.C. § 103(a) as being unpatentable over Li. The rejection is based on a combination of disclosures in Li with

the disclosures of the two Barbee references '121 and '386. The Examiner states "in the light of the above disclosure, it would have been obvious to one having ordinary skill in the art at the time of the instant invention to utilize styrene polymers of Li in the composition of Barbee and thereby obtain the same invention." The Li reference is directed to rubber-toughened thermoplastic nanocomposite materials comprising a blend of at least one thermoplastic engineering resin, an elastomeric functionalized copolymer of a C_4 to a C_7 isomonoolefin and an exfoliated clay dispersed in the composition. While it may have been obvious to use the styrene polymers of Li in the composition of Barbee, the above discussion regarding the Barbee references underscores the fact that the methodology disclosed by Barbee is at significant variance with the innovative methodology of the present subject Application as reflected in the Specification and currently amended Claims. Insofar as the differences between the present invention and the disclosure of Barbee '121 and '386 are believed to be more than simply the difference of the matrix polymers used, the use of the Li reference to introduce the polystyrene as a matrix polymer does not bring the methodology of Barbee any closer to the process of the present subject Application. It is therefore believed that the combination of these references lack essential elements contained in the newly-amended Claims of the present subject Application, as discussed in detail above, and thus, it is further believed that the 35 U.S.C. § 103(a) rejection of Claims 2-5 is improper.

For all of the above reasons, it is believed that the present subject Application in its currently amended form overcomes the Examiner's rejections as contained in the Office Action of 18 November 2003, and that the subject Patent Application has been placed in condition for allowance, and such action is respectfully requested.

Respectfully submitted,
FOR: ROSENBERG, KLEIN & LEE

Harry L. Sernaker
Registration #50,595

Dated: 18 February 2004

3458 Ellicott Center Drive, Suite 101
Ellicott City, MD 21043
(410) 465-6678